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THE DEVELOPMENT OF ROLLED METAL PRODUCTION IN THE PEOPLE'S REPUBLIC OF CHINA

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The Chinese People's Republic inherited from old semifeudal China an extremely backward metals industry; rolled metal production was one of the weakest branches. Up to 1959 China had only a small number of obsolete rolling mills in Anshan, Shanghai, Chungking, Ta-yeh and in some other places which turned out limited amounts of sheet steel and medium and light sections. Maximum rolled metal production during this period reached 686,000 tons. In 1949 only 123,400 tons of rolled metal were turned out. In old China there was no production at all of heavy rails, large girders, high-grade rolled metal made of prime steel, no sheet metal for electrical engineering or other types of rolled metal.

A distinctive feature of the rolled metal industry of the Chinese People's Republic is the high rate of growth. Data on the increase in rolled metal production for the period 1952-1958 are given in Table 1.

TABLE 1

Increase in Rolled Metal Production in China From 1952 to 1958

Year	% of 1952 index (100%)	% Increase Per Year	Comments
1952	100	--	End of reconstruction period
1953	134	34	First year of first five-year plan
1954	159.3	18.8	
1955	200.3	25.7	
1956	290.0	44.8	
1957	386.5	33.3	Last year of first five-year plan
1958	549.4	42.1	First year of second five-year plan

Thus over a period of six years rolled metal production in China increased 5.5 fold with the average yearly increase amounting to 32.8%. The liberated Chinese people during the reconstruction of the national economy and the carrying out of the first five-year plan constructed a number of modern rolling plants including the 1,150 blooming and slabbing mills with a capacity of more than 3,000,000 tons per year, the 800 rail and girder mills with a complex of auxiliary equipment for processing heavy rails and heavy shaped sections, a shop for making seamless pipe up to 165 mm in diameter, and shops for the production of shapes and sheet steel. During the first five-year plan existing rolling mills were expanded and modernized.

The construction of new, and the modernization of existing, plants made it possible during the first five-year plan to organize the production of prefabricated rolled stock from blanks produced from large castings. At the end of the first five-year plan China was rolling 5000 shapes and dimensions (besides nails, bolts, etc.) including heavy rails, large beams up to no. 45 in size, channel bars of all sizes, seamless pipes, sheet metal for electrical engineering, shapes from high-grade and alloyed steels and thick and thin sheet from high-carbon and alloy steel.

The second five-year plan for the development of the national economy gave rolling mill workers in China still more extensive objectives in increasing production to satisfy as fully as possible the demands of the country for various types of products.

On the basis of the plan for the development of socialism as worked out by the Central Committee of the Chinese Communist Party on the principle "more, faster, better, cheaper" Chinese metalworkers have expanded rolled metal production and, indeed, the entire ferrous metals industry by combining the creation of major highly mechanized and automated rolling mills with the construction of medium and small rolling mills with mechanization developed by local initiative.

The first operating metallurgical center, the first producer of technicians and achievements in the Chinese People's Republic was the Anshan Metals Combine, the second and third were the Wuhan and Paotow Metal Combines where first-class rolling mills will be built.

The principal production of medium and light rolled metal takes place in Shanghai.

In China at present, 825-1150 blooming mills have been installed and are in operation as well as continuous billet mills one of which includes a stand with vertical rollers (all stands are driven by a d.c. motor with regulated roller revolutions).

In technical specifications they are better than analogous mills in the United States. We should also mention the semicontinuous sheet mill which produces a wide variety of thick and thin sheet, the 800 rail and structural steel mill with an almost doubled production capacity, a seamless tube mill with auxiliary equipment and other mills. Under construction are the following high-production mills: the 1150 blooming and slab mill, the 300 continuous light-section mill consisting of 15 frames which can roll 10-35 mm round and square steel, 8 kilogram rails, strips steel and other shapes, the 250 4-ton continuous wire mill consisting of 39 stands for rolling 5.5-10 mm wire with full mechanization and automation and a rolling speed of 28 metersper second, several sheet mills for cold rolling.

In tube production the country is building and putting into operation units for the electric welding of 20-650 mm tubes with equipment for finishing and testing.

Along with the most recent rolling mills in China there are in operation or under construction a large number of less highly mechanized rolling mills of medium and low production capacity which are playing and will play an important role in providing the national economy with rolled metal until there has been a complete reconstruction of the rolled metal industry along modern standards.

Most characteristic of this group of mills are: (1) the 700 single-stand blooming mill for rolling ingots weighing 1.8 - 2 tons into blooms measuring 150 x 150 and 170 x 170 millimeters with which are installed two 500 three-high frames for rolling blooms into 80 x 80 and 60 x 60 mm billets for the medium-section or wire mill; (2) 900/800 large-section mills consisting of a reversing stand with regulated roller revolution and three 800 stands in a single line for rolling ingots weighing up to 3 tons into billets or heavy sections from a single heating; (3) 650 large-section mills consisting of 3 three-high frames with a 2300 kilowatt a.c. electric motor drive for rolling ingots weighing 600 kilograms into blanks or complete sections; (4) 500/300 mills consisting of seven stands arranged in two lines and 400/250 two-line mills consisting of six stands for the production of light sections; (5) 750/500/750 three-high single-stand mills with roller working surfaces 2300 mm long and equipment for heating ingots or slabs, and for transporting and cutting metal; (6) 650-760 two-high mills with rollers 950, 1100 and 1200 mm long for hot rolling sheet steel by the faggot method; most often the 1200 repeater mills are installed in two, four and six stands with each two stands driven through a reducing gear from an independent 1000 kilowatt electric motor; (7) slightly mechanized tube mills consisting of a piercer and two stands for final shaping of the pipes in the production of seamless tubes.

With existing facilities Chinese rolling mill operators have carried out a number of measures which have greatly increased mill productivity. In 1958 alone this resulted in an increase of more than one million tons in the Chinese People's Republic.

Among the most important measures put into operation in existing rolling mills in 1957-1959 the following should be pointed out:

On blooming mills:

1) in order to increase section productivity of soaking pits auxiliary groups of recuperative and regenerative soaking pits have been installed on 1150 and 1100 blooming mills, ingot temperature has been increased when they are placed in the soaking pits, liquid slag removal has been adapted for both regenerative and recuperative soaking pits. It should be pointed out that liquid slag removal from recuperative soaking pits and the low heating of ingots by the installation of four auxiliary burners in the lower part of the walls of each cell have given positive results. The productivity of groups working with liquid slag and with low heating has increased 10-12%.

2) On the 1100 blooming mill the single electric motor of 5500 horsepower for the main drive has been replaced by two with a drive for each roller from an independent 3500 horsepower motor and 0 - 40 - 60 - 80 - 100 r.p.m. This has made it possible to increase mill productivity by 500,000 tons per year.

3) The weight of ingots has been increased from 5.6 to 8.3 tons for the 1100 blooming mill.

4) the size of blooms has been increased on the 1150 mill from 300 x 300 to 350 x 350 mm; on the 1100 mills from 240 x 240 to 280 x 300.

5) In 1958 simultaneous rolling of two ingots on the 1150 mill was adopted.

On continuous billet mills. Here an increase in productivity resulted from increasing the original and final cross sections of the blooms and billets. For instance, on the 850/700 twelve-stand mill with vertical rollers the section of the original blooms increased from 300 x 300 to 350 x 350 mm; on the 600 continuous billet mill from 195 x 195 to 240 x 240 mm; in addition, for tilting strips between stands tilting rollers have been installed instead of helicoidal wires which reduced rolling time by 20-30 minutes and improved the surface of the rolled billets.

We have the largest number of measures on section mills producing largely market products.

1) At a number of plants the capacity of the heating apparatus was increased through the construction of new heating furnaces. At present some factories have built and are using several furnaces operating on blast-furnace gas. At one plant a four-row holding furnace for heating ingots weighing up to one ton is in operation. In Shanghai an experimental heating furnace of an original design with two layer placement of heated billets in the furnace has been built and is in operation. This furnace is loaded from the end, the upper layer of billets if fed into the end and the lower from the side. The furnace operates on coal. The length of the upper stage is 16.5 meters and the lower 12.3; furnace width is 2.0 meters and capacity is 27 tons per hour.

2) In 1958-1959 work has been done on replacing the electric motors for the main drives of the roller stands with more powerful and faster ones.

3) With section mills of all categories there has been extensive use of the "multipart" rolling system (rolling with covers, several strips are rolled simultaneously in a finishing stand).

Heavy rails are rolled with the simultaneous passage of three or four strips through a stand, beams and channel bars with two or three strips, and light section round shapes with three, four or more strips passing through the stands simultaneously. Medium and light section steel is being rolled simultaneously on two or three finishing grooves and rolled wire is being rolled largely into four strands.

At Shanghai Plant No. 2 and the Shenyang Metals Plant it is hoped to roll wire simultaneously into six strands on the finishing line of a continuous line mill.

4) One of the most important measures for increasing the production of current mills in a line arrangement is the introduction of rolling in two flow lines which is done by creating two lines of metal of the same or different shape by a) leading off a part of the metal from the breaking-down stand in the form of a billet for cutting (in this case the shape being rolled on the mill is taken from the finishing stand); rolling in this case is done "by ones", i.e. the rolling of one strip is finished on the first stand, the second on the finishing stand, the third on the first, the fourth on the finishing stand, etc.; b) by partial reconstruction of the shops with installation of auxiliary equipment which makes it possible to roll different shapes in two flow lines through a series of stands arranged in two lines.

The first method is used where billets are rolled in the first stand and sheet bars in the finishing stand at the Taiyuan Combine. The second method is used for operating the 500/360 light-section mill at plant No. 3 in Shanghai and the 400/250 light-section mill of the Tangshan Metal Combine. The Yearly production with two-line rolling has increased on the 500/360 mill depending on the shapes being rolled up to 1.4 fold and on the 400/250 mill 1.5 fold.

5) On all section mills work has been done and is being done in improving the grooving or rollers by reducing the number of passes and their correct location in the stands. For example, on the rail and structural steel mill the number of passes in rolling rails has been reduced from 11 to 9. Widespread attention is being given to a method for grooving structural steel on inclined grooves, channel bars with corrugated webs, etc.

6) In order to increase the production of light-section and wire mills and improve the quality of round shapes the last two stands are located in tandem which form a continuous group. In particular this measure has been adopted in the linear wire mill of plant No. 10 in Shanghai where the last stand has been followed by an auxiliary two-high stand with both stands driven by a single electric motor through a multiple V-belt drive. This has made it possible to feed oval-shaped strips directly into the finishing circle with turning the oval in the tube by 90°, excluding the use of a guide apparatus, and to eliminate defective rolled material from the seizing of strips during passes in feeding of the oval through the guide apparatus into a finishing ring 6-8 mm in diameter.

7) In order to improve the finished shape of rolled wire on the wire mill at the "Hsinghu" Plant after the finishing stand were installed two pairs of vertical rolls with belt-drive from horizontal rolls which makes it possible with slight pressure on the strips from the vertical rolls to obtain an exact shape of round wire.

8) Guiding apparatus is operating successfully on existing light-section mills of Shanghai and other plants. In Shanghai rod, strip and angle steel is being rolled with guide apparatus. One 280 mill of the northeast is operating using guide apparatus and roller fittings.

In Table 2 we have indicators of the operation of several section mills.

On sheet mills. A large part of the sheet steel in the Chinese People's Republic is at present produced on two-high sheet mills. The principal measures introduced for these mills are a) the introduction of conveyor furnaces to heat the sheet bars and piles; b) rolling four sheet bars simultaneously; c) rolling sheet bars and piles simultaneously on a single stand; d) mechanizing rolling by installing two-stage tables designed by engineer T'ang Fu-ling.

Data on the operation of the three shet mills are given in Table 3.

In carrying out their extensive program of constructing rolling mills the Chinese metallurgists have introduced much that is new and interesting which has a marked effect on the rising technical level of Chinese machinery builders and rolling mill workers. It is enough to point out that at present in China the Chinese themselves are making an 1150 blooming mill, an 850/650 heavy-section mill and several rail and structural steel mills are being planned and will soon be produced. During the last half of 1958 and this year there has been widespread adoption of a method for processing the larger parts of rolling mills by the "ant gnaws a bone" method, i.e. by means of small lathes using all sorts of fittings invented by workers, engineers and technicians.

The operation of the newly installed rolling mills has required the training of large numbers of personnel, principally young people who have come from the towns and villages of China to study in the rolling mill sections of the Anshan, Taiyuan, and Chungching Combines and other plants.

Through the expansion of their metal industry at a rate unheard of in the capitalist countries the Chinese people have written one of the most brilliant pages in the history of the development of socialism in the Chinese People's Republic.

TABLE 3

Data on the Operation of the Sheet Mills in China

Mills	Total Production		Productivity in actual hours of operation ton/hour		% of operating time	
	1958	6 mos 1958	1958	6 mos 1958	1958	6 mos
Mill A	82.9	57.2	2.78	3.77	75.70	
Mill B	95.2	46.3	3.36	3.42	80.74	78.0
Mill C	33.8	24.3	2.53	2.98	83.6	

TABLE 2

Operational Indexes for Certain Section Mills in China

Mills	Brief tech. specifications	Total Production			Production per actual hour of operation ton/hr		
		'57	'58	'59	'57	'58	'59
800 rail and structural steel	3 Stands in line	730.0	892.4	436.0	132.4	149.2	142.9
650 large section mill	3 Stands in line	176.4	220	126.0	26.8	29.9	35.0
580 medium section mill	4 Stand driven by 2 electric motors	480	540.1	284.7	79.7	84.2	92.1
500/360	2-line: 1st line: 2-500 stands 2nd line: 4-360 stands	184.6	320.7	161.7	27.1	45.2	44.8
330 light section mill	2-line 435/330 made of 2/0 stands		237.7	128.7		32.4	34.6
400/250 light section mill	3-line 1st line- 2 400 stands 2nd line- 6 250 stands 3rd line- 4 250 stands	113.4	115.0	79.0	14.6	16.5	22.6

Operational Indexes for Certain Section Mills in China — TABLE 2 (CONT'D)

Mills	Brief tech. specifications	Operating time % '57	'58	'59	Remarks
800 rail and structural steel	3 Stands in line	63.5	63.0	70	Rolls rails, beams, channels, angles
650 large section mill	3 Stands in line	84.2	84.5	82.7	Rolls billets, sheet bars, light rails, channel bars, beams
580 medium section mill	4 Stand driven by 2 electric motors	71.4	73.4	74.0	Rolls beams, channel bars, light rails, flange plates
500/360	2-line: 1st line: 2-500 stands 2nd line 4-360 stands	77.8	81.1	83.2	Rolls billets for 8 kg rails, channel bars 6 5 and 9, 75 x 75 mm angles. Since 1958 operates in two flow lines
330 light section mill	2-line 435/330 made of 2/0 stands		84.4	85.7	Rounds 9 - 32 mm and regularly variable shapes up to 30 mm
400/250 light section mill	3-line 1st line- 2 400 stands 2nd line- 6 250 stands 3rd line- 4 250 stands	89.3	85.5	80.6	Rolls rounds 16-22 mm, operating as 2 flow lines since second half of '58

END